GEOLOGIC CHARACTERIZATION OF LAKE MAGNOLIA

CLAY COUNTY, FLORIDA

By

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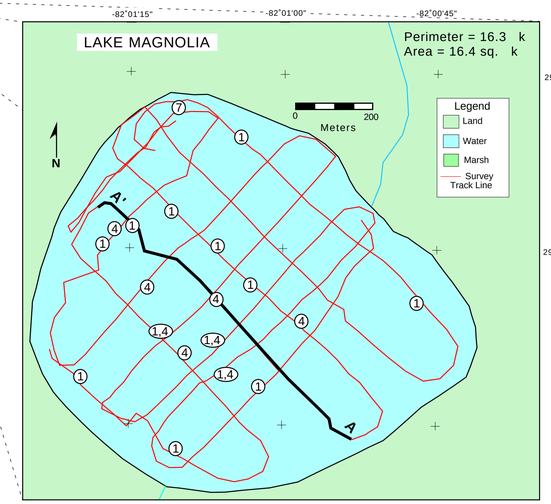


INTRODUCTION

The potential fliud exchange between lakes of northern Florida and the Floridan aquifer and the process by which exchange occurs is of critical concern to the St. Johns River Water Management District (SJRWMD). High-resolution seismic tools with relatively new digital technology were utilized in collecting geophysical data from > 40 lakes and rivers. The data collected shows the application of these techniques in understanding the formation of individual lakes and rivers, thus aiding in the management of these natural resources by identifying breaches or areas where the confining units are thin or absent between the water bodies, the Intermediate aquifer and the Floridian aquifer.

This study was a cooperative investigation conducted from 1993 to 1996 by the SJRWMD and U.S. Geological Survey Center for Coastal Geology (USGS). Since 1989 there have been technical and hardware advances in the digital acquisition of high-resolution seismic data. The primary objective of this cooperative was to test newly developed digital high-resolution single-channel marine seismic continuous-profiling-equipment (HRSP) and apply this technology to identify subbottom features that may enhance leakage from selected lakes and the St. Johns River. The target features include: (1) identifying evidence of breaches or discontinuities in the confining units between the water bodies and the aquifer, and; (2) identifying areas where the confining unit is thin or absent.

METHODS

In cooperation with SJRWMD the USGS acquired and upgraded a digital seismic acquisition system. The Elics Delph2 High-Resolution Seismic System was acquired with proprietary hardware and software running in real time on an Industrial Computer Corp. 486/33 PC. Hard-copy data was displayed on a gray scale thermal plotter. Digital data was stored on a rewritable Magneto-Optical compact disk. Navigation data was collected using a Trimble GPS or PLGR (Rockwell) GPS. GeoLink XDS mapping software was used to display navigation.

The acoustic source was the Huntec Model 4425 Seismic Source Module and a catamaran sled with an electromechanical device. Occasionally, an ORE Geopulse power supply was substituted for the Huntec Model 4425. Power was set at 60 joules or 135 joules depending upon conditions. An Innovative Transducers Inc. ST-5 multi-element hydrophone was used to detect the return acoustical pulse. This pulse was fed directly into the Elics Delph2 system for storage and processing.

Thirteen line-km of HRSP data was collected from Lake Magnolia. A velocity of 1500 meters per second (m/s) was used to calculate a depth scale for the seismic profiles. Measured site specific velocity data is not available for these sites.

These surveys were conducted in part to test the effectiveness of shallow-water marine geophysical techniques in the freshwater lakes of central Florida. Acquisition techniques were similar but modifications were necessary. Data quality varied from good to poor with different areas and varying conditions. As acquisition techniques improved so did data quality in general. In many areas an acoustic multiple masked much of the shallow geologic data.

PHYSIOGRAPHY

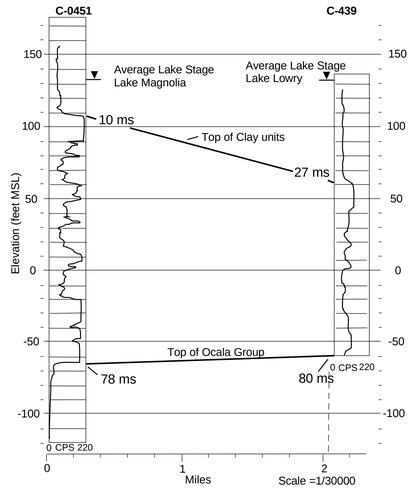
Lake Magnolia is on the southwest boundary of Clay County, Florida. The lake is located in the Interlachen Sand Hills of the Central Lakes District. Lake level at the time of the seismic survey was 38.1 m (125 ft) NVGD. Lake Magnolia is oval shaped approximately 1.1 x 0.9 km with a of perimeter 3.2 km and the surface area 0.8 sq km. Average water depth during the survey is 6 to 7 m (19 to 23 ft). The lake is bordered by woodlands.

GEOLOGIC CHARACTERIZATION

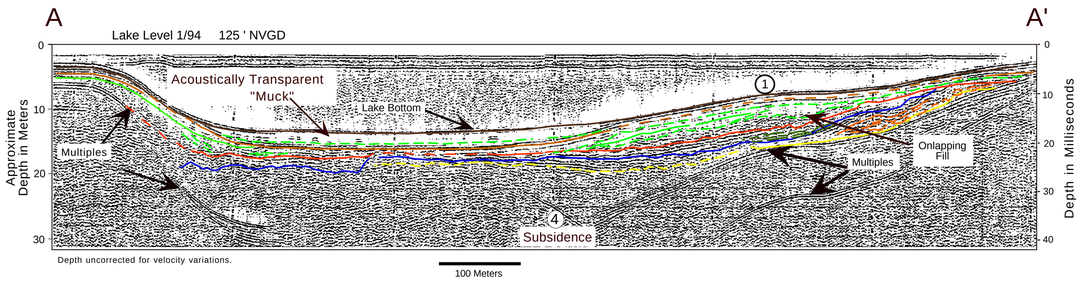
Profile A-A' shows the basic character of Lake Magnolia, it appears to be comprised of a single depression. The characteristics of this lake are very similar in to Kingsley Lake, Blue Pond and several other lakes in the region. The subbottom was disturbed during the subsidence then covered and infilled similar to Type 1 and 4 karst features described in the Explanation. In the northwestern corner of the lake is a buried block that has rotated and slumped into the sink (Type 7 karst feature).

The main depression is continuous across the lake in both of the predominant traverse directions. The Profile A-A' from Magnolia Lake shows a shallow nearshore with a deepening towards a center containing a singular subsidence with onlapping fill on the northwest flank. In the central portion of the lake is an undisturbed surficial layer that is acoustically transparent and possibly high-organic "muck" or soft clayey sediments. The undisturbed surficial sediments implies that there has been little to no subsidence recently.

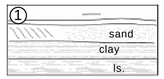
Comparison of gamma logs from boreholes to contacts seen in the seismic records is difficult. Log C-0451 is from a well approximately 1 km west of Lake Magnolia and Log C-0439 is from a well located on the northwest shore of Lake Lowry. The units identified from the gamma logs are the clay confining of the Hawthron Group and the top of the Ocala Limestone Group.



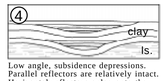
Gamma log cross section Lake Magnolia (C-0451) to Lake Lowry (C-0439) (to the north). Clay units exhibit high gama counts. Estimated depths (milliseconds (ms) two-way travel time) are labeled where the formation contacts should be seen in the seismic records near these boreholes.



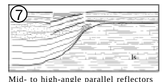
EXPLANATION



Undisturbed section, with or without upper non-reflective sand layer. Sand layer may show reflection where cross bedding from original deposition (fluvial or aeolian) exits. Clay layers are mostly intact.



Low angle, subsidence depressions. Parallel reflectors are relatively intact. Horizontal reflectors onlap onto the subsided parallel reflectors and represent deposition during subsidence. These can be large basin size features or tens of feet.



Mid- to high-angle parallel reflectors with indications of vertical displacement and rotation. Feature may be buried by overburden. Represents blocks from the sides of collapse sinks that have slumped into the sink.